

FIG. 1

(prior art)

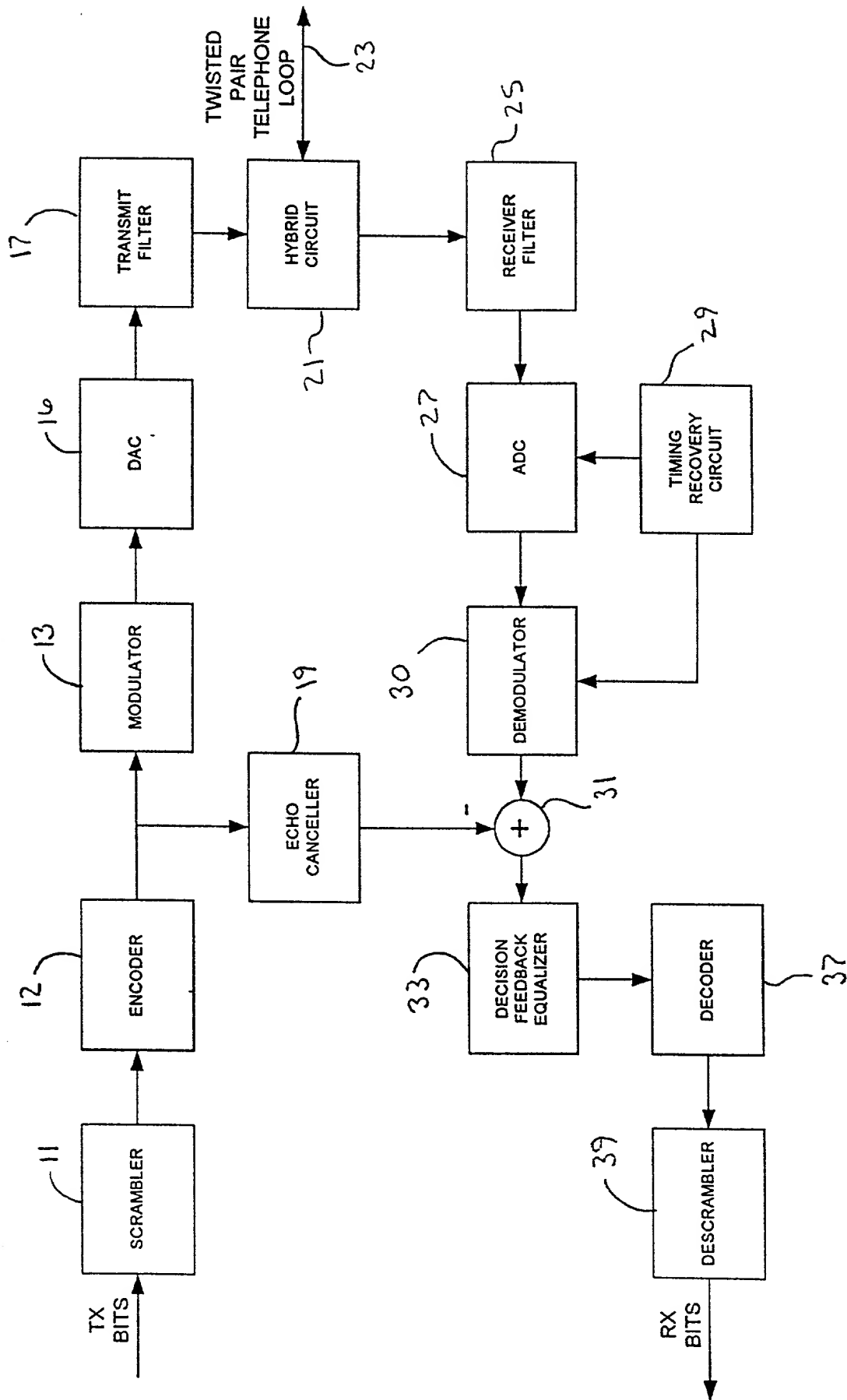
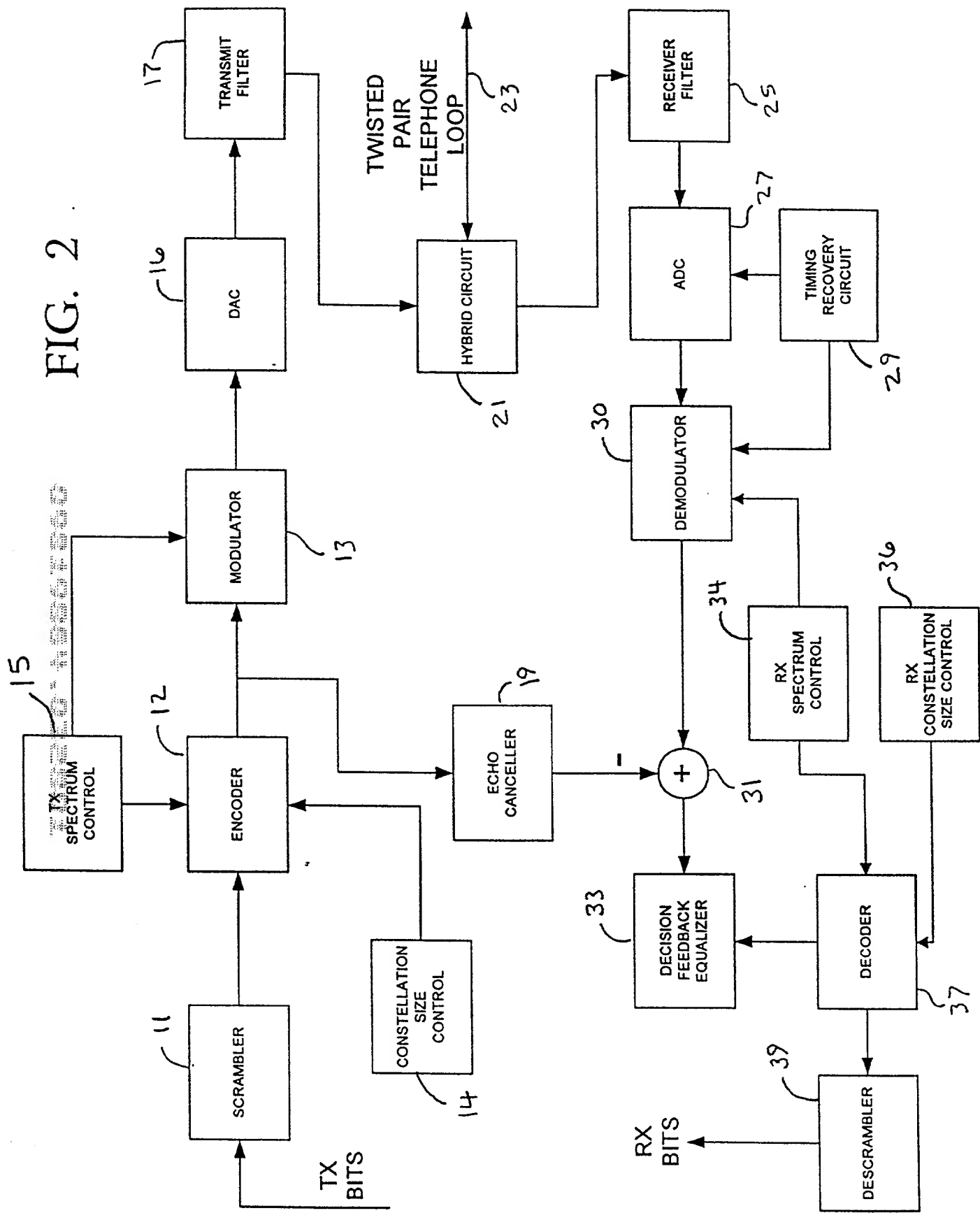


FIG. 2



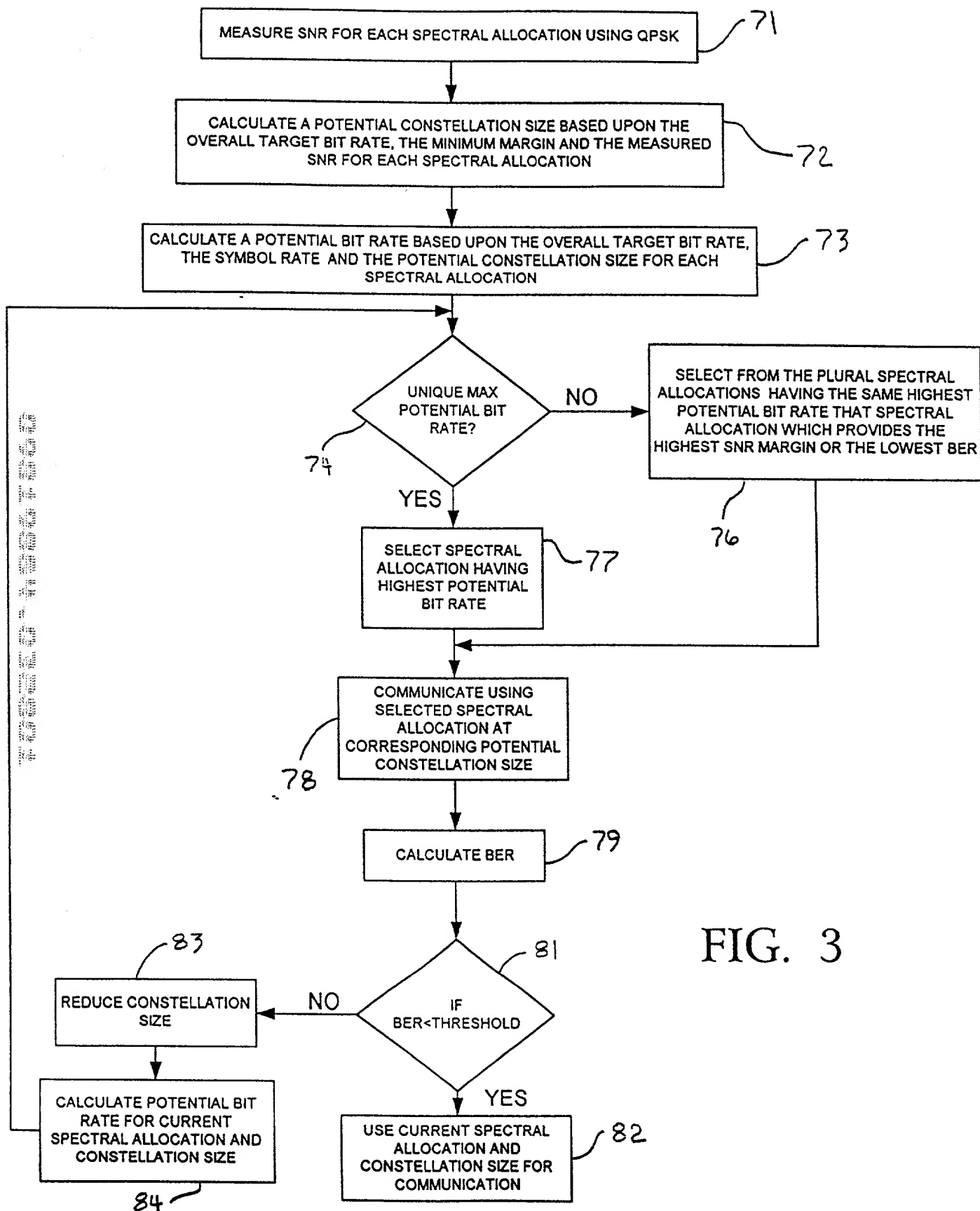
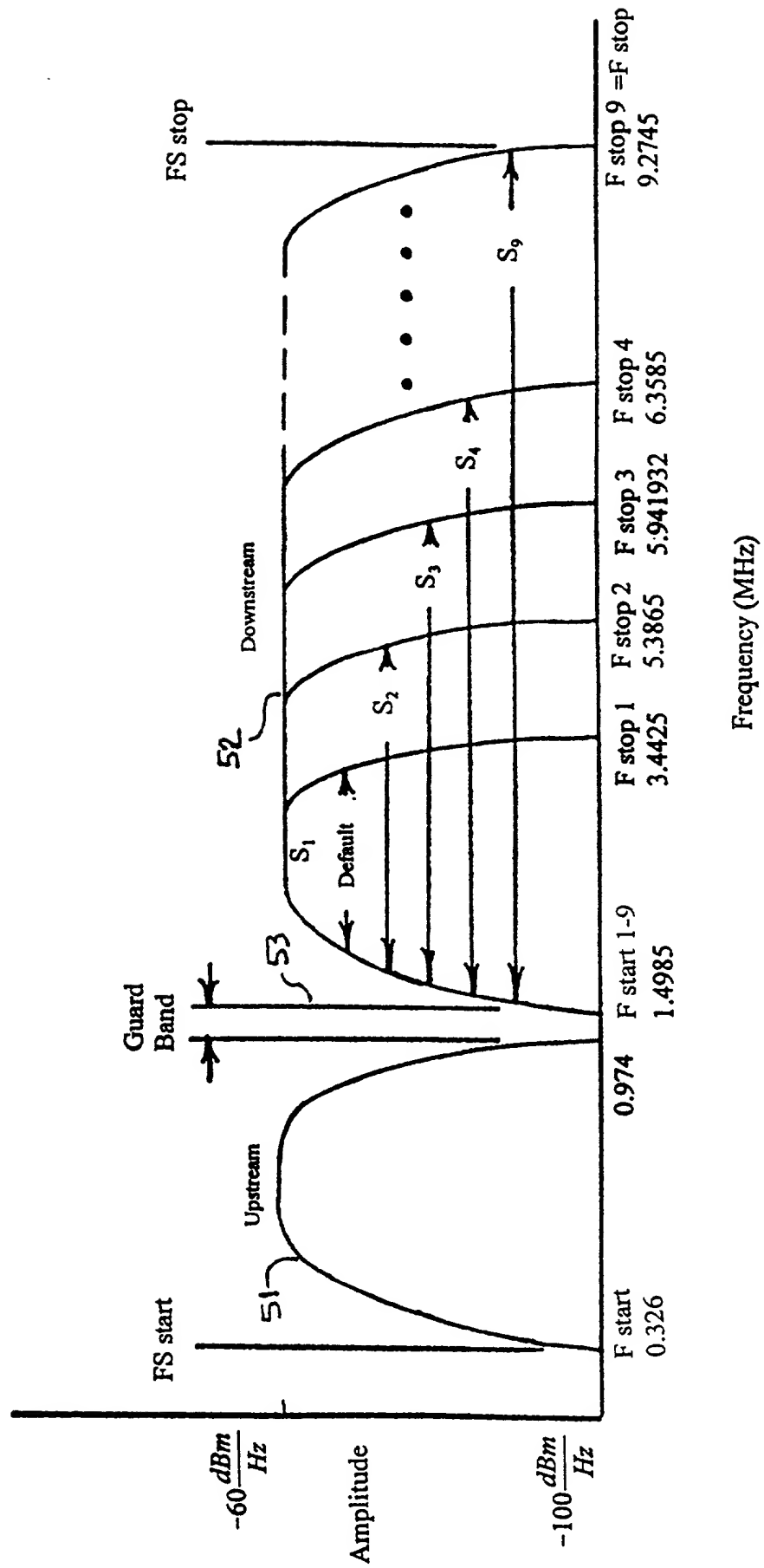


FIG. 3

FIG. 4



Symbol Rate (Bandwidth)	SNR (measured)	Potential Constellation (Assuming 3 dB SNR Margin and Overall Target Rate = 25.92 Mbps)	Potential Bit Rate
$S_1 = 1.62$ Mbaud (Default)	40 dB	256	12.96 Mbps
$S_2 = 3.24$ Mbaud	38 dB	256 ⁽¹⁾ 128	25.92 ⁽¹⁾ 22.68 Mbps
$S_3 = 3.70286$ Mbaud	34 dB	128 ⁽²⁾ 64	25.92 ⁽²⁾ 22.21716 Mbps
$S_4 = 4.05$ Mbaud	31 dB	128	25.92 ⁽³⁾
$S_5 = 4.32$ Mbaud	28 dB	64	25.92
$S_6 = 4.86$ Mbaud	27 dB	32	24.3
$S_7 = 5.184$ Mbaud	26 dB	32	25.92 ⁽⁴⁾
$S_8 = 5.67$ Mbaud	22 dB	16	22.68
$S_9 = 6.48$ Mbaud	16 dB	4	12.96

NOTE: FEC payload percentage = 1 (No FEC)

- (1) BER test failed.
- (2) QAM-128 initially selected instead of QAM-256 due to value of overall target rate. BER test at QAM-128 subsequently failed.
- (3) Potential bit rate > target rate; target rate entered in table, and FEC payload percentage optionally reduced.
- (4) S_7 ultimately used for communication.

FIG. 5

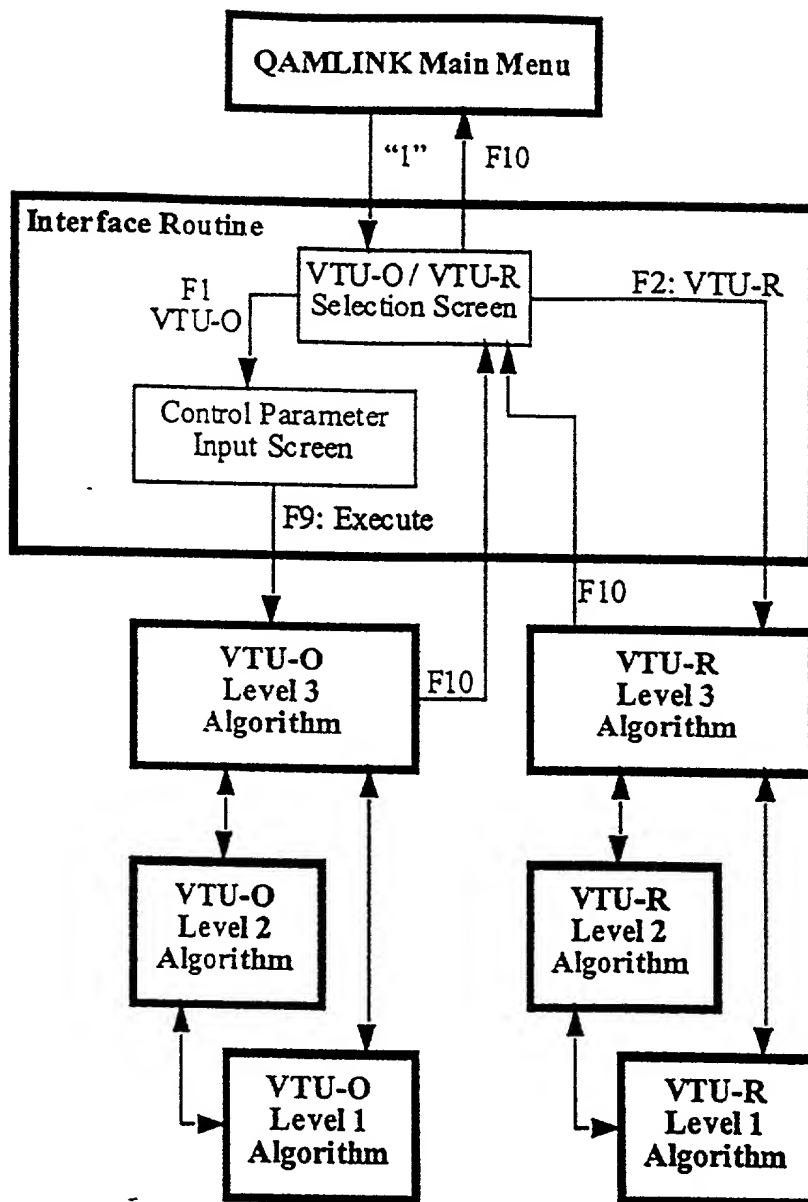


FIG. 6

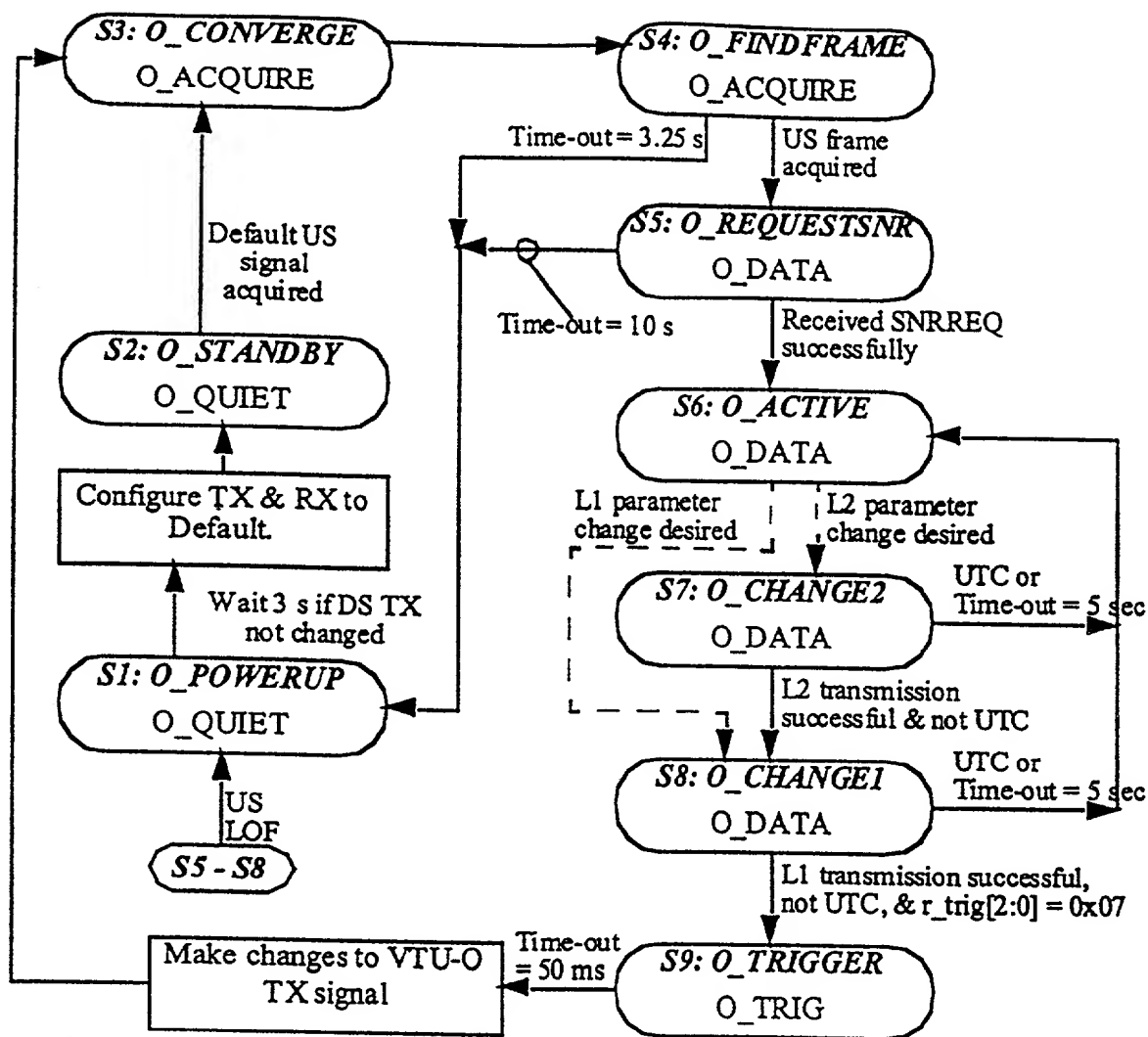


FIG. 7

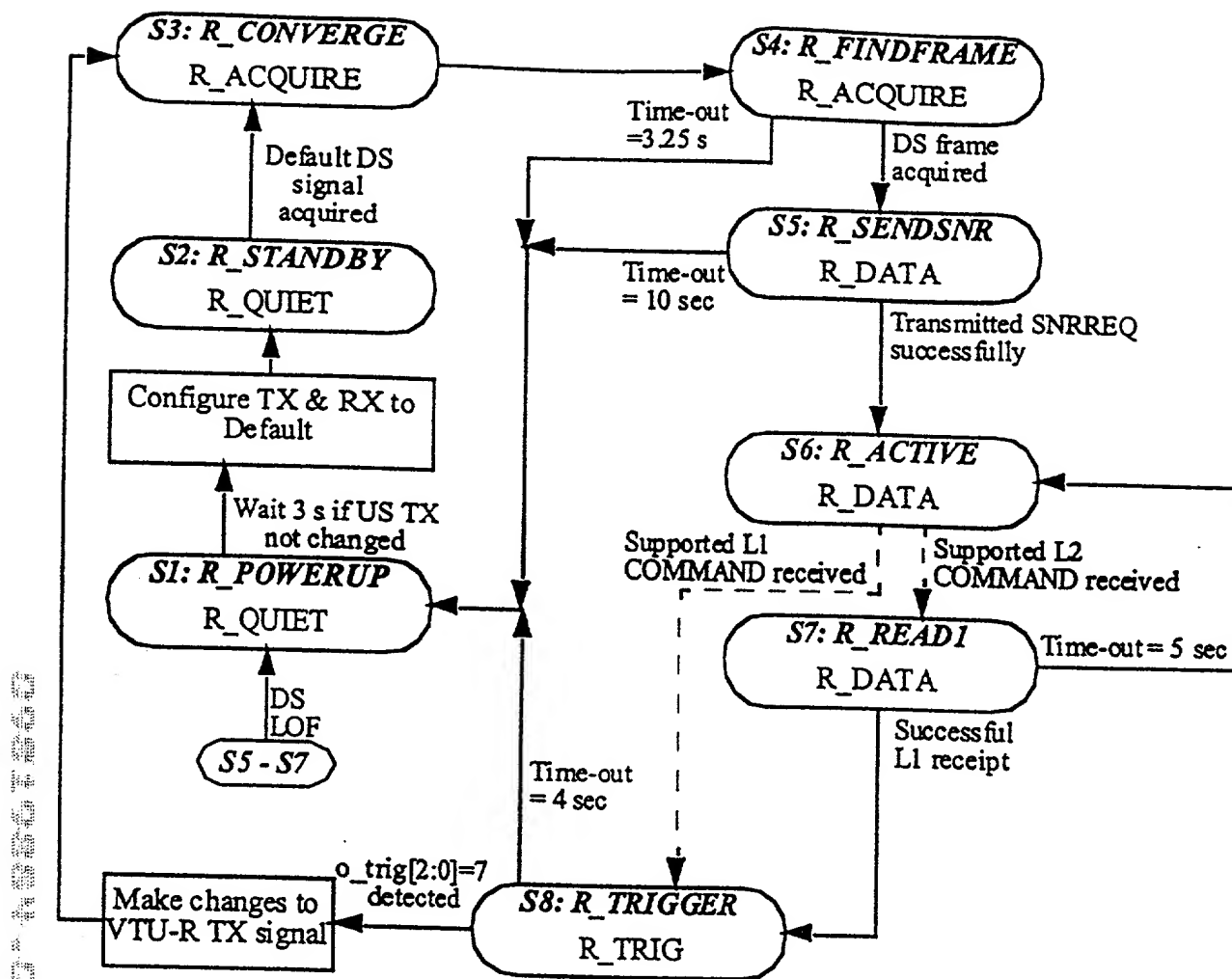


FIG. 8

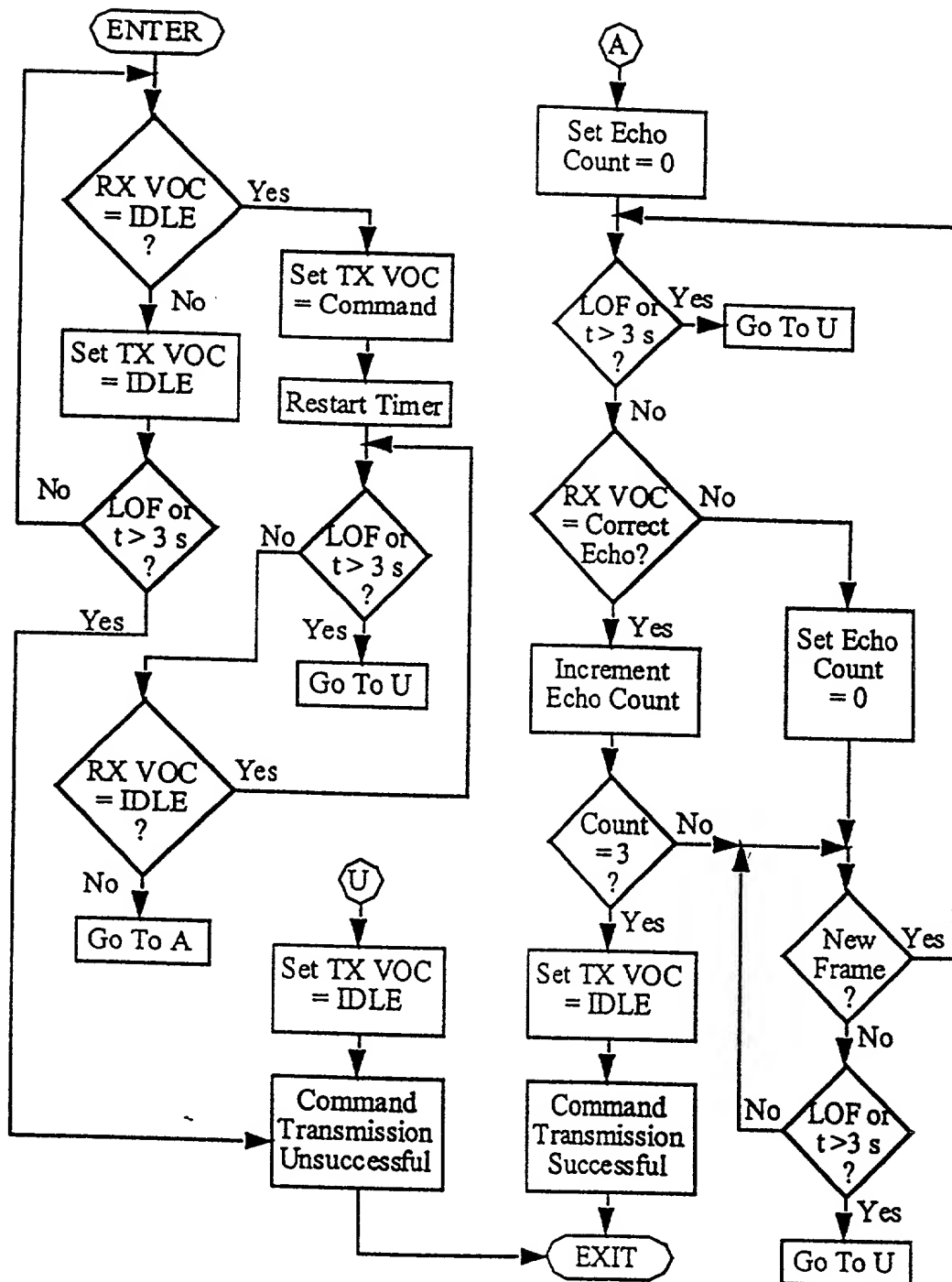


FIG. 9

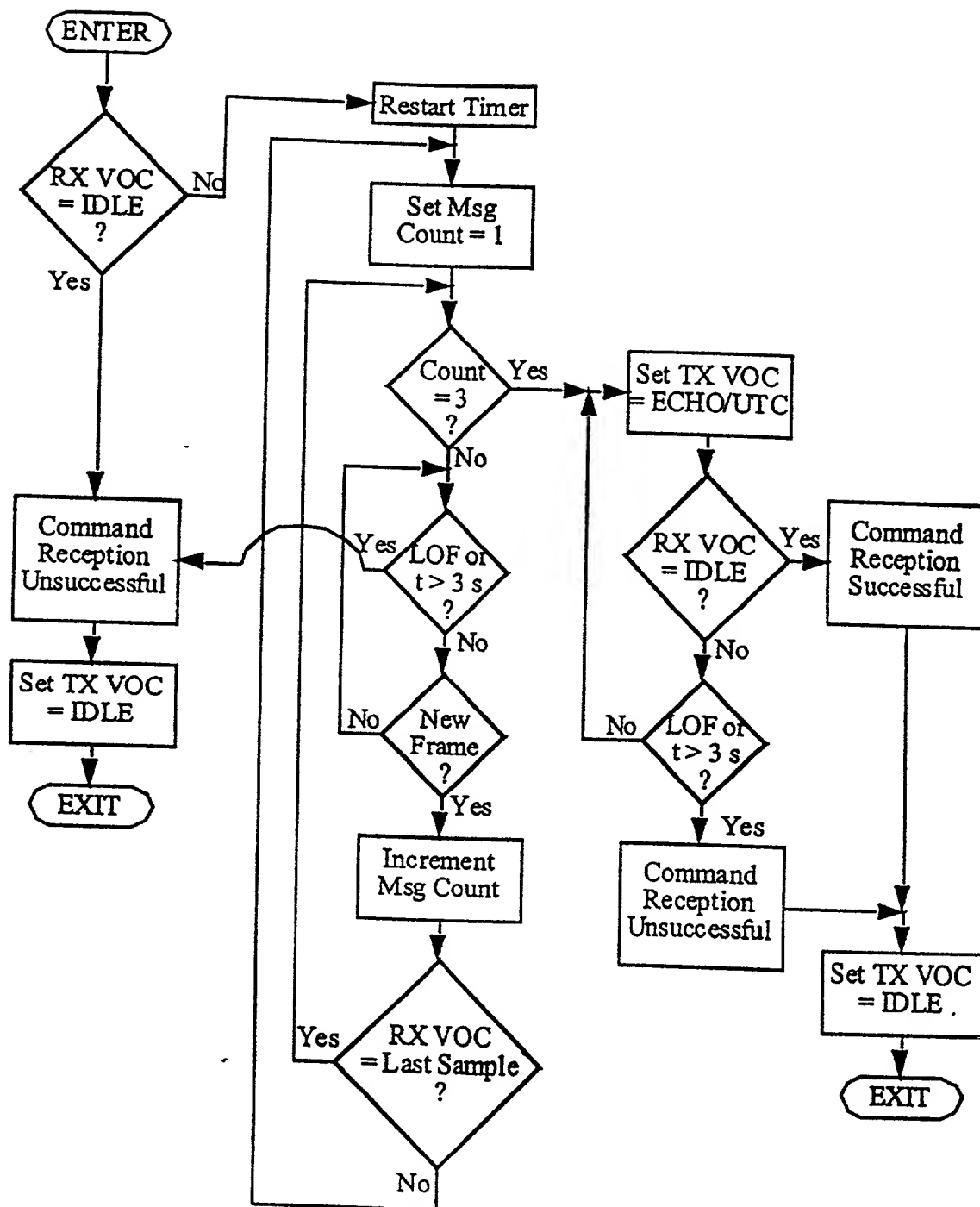


FIG. 10

FIG. 11

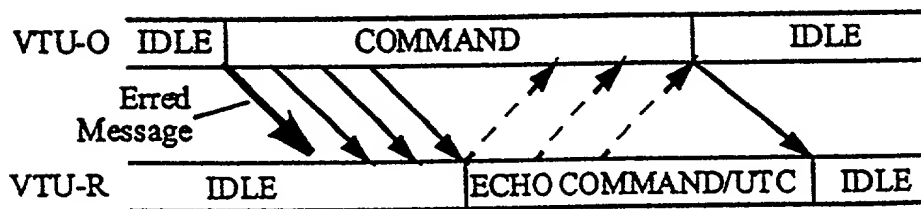
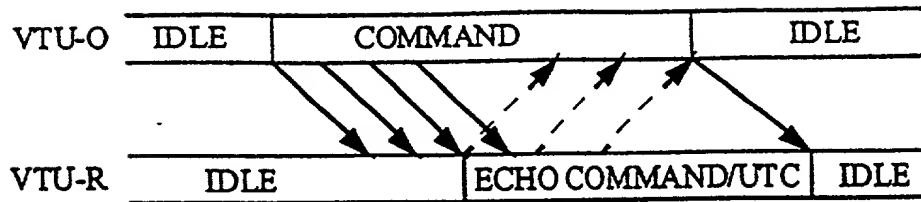


FIG. 12

Received VOC COMMAND	ECHO Opcode	ECHO Data
D_NOM (0x34)	D_NOM (0x34)	Same as COMMAND data
D_CONST (0x28)	D_CONST (0x28)	Same as COMMAND data
U_CONST (0x98)	U_CONST (0x98)	Same as COMMAND data
SNRREQ (0x01)	SNRREQ (0x01)	Downstream Avg. SNR
CORERREQ (0x05)	CORERREQ (0x05)	Number of Reed-Solomon corrected errors
UCERREQ (0x07)	UCERREQ (0x07)	Number of uncorrectable Reed Solomon blocks
Else	UTC (0xF0)	Same as COMMAND data

FIG. 13

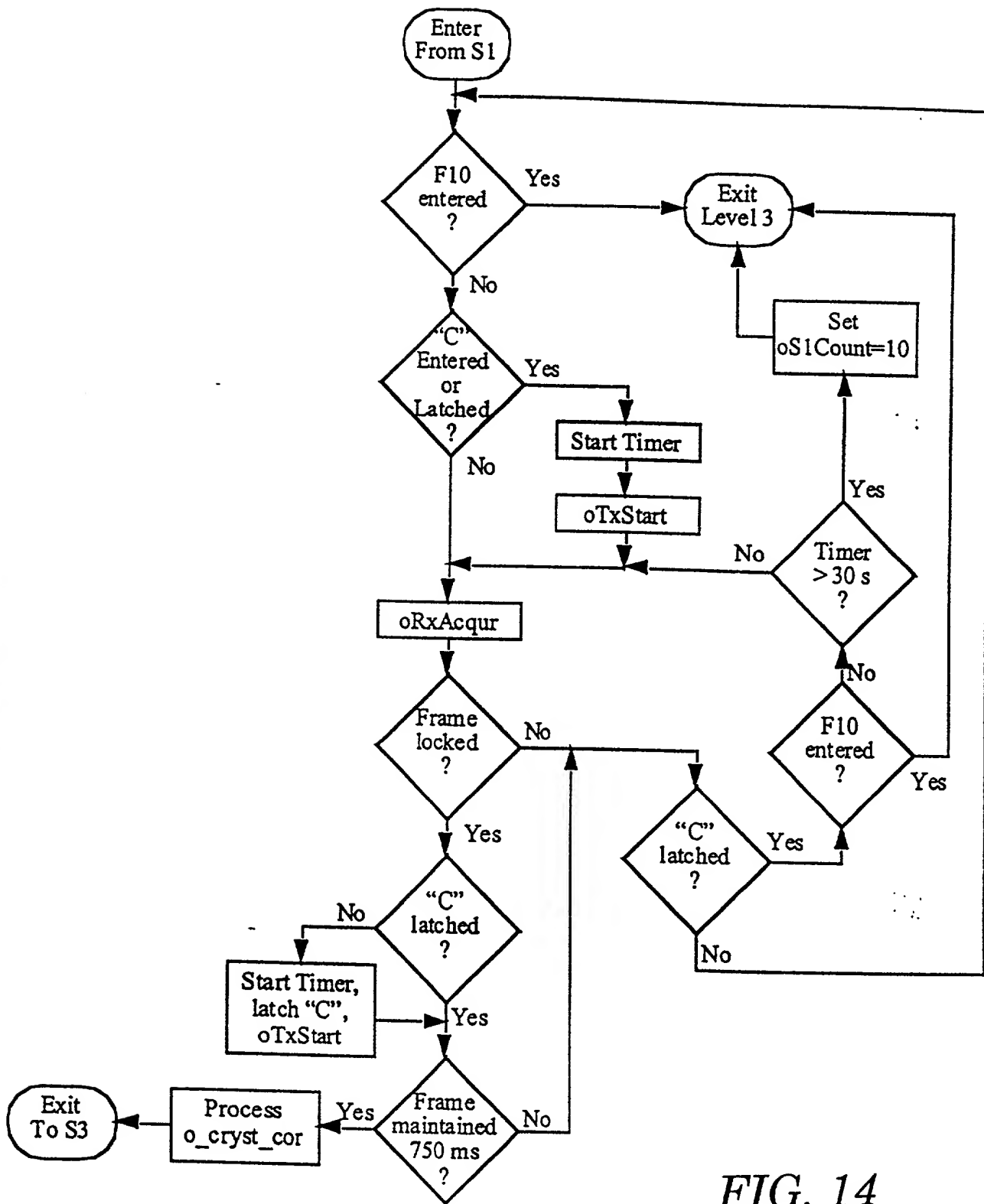


FIG. 14

FIG. 15

Parameter	Valid Values
Upstream Symbol Rate	Any integer value between 405E3 baud and 810E3 baud
Upstream Constellation	4, 8, 16, 32, 64, 128, 256
Upstream Interleaving Depth	Any integer between 1 and 16 (up to 29 for reduced codeword sizes)
Upstream Transmit PSD Level	Any integer between 0 and 63 (PSD[dBm/Hz] = Value – 100)
Upstream Center Frequency	Range depends on symbol rate, granularity = 1 Hz
Upstream Frame Structure	Includes sync word, uncoded control, coded control, and Reed Solomon code word, all of programmable size
u_nom	0x0003
Downstream Symbol Rate	Any integer value between 1.62E6 baud and 12.96E6 baud
Downstream Constellation	4, 8, 16, 32, 64, 128, 256
Downstream Interleaving Depth	Any integer between 1 and 16 (up to 29 for reduced codeword sizes)
Downstream Transmit PSD Level	Any integer between 0 and 63 (PSD[dBm/Hz] = Value – 100)
Downstream Center Frequency	Range depends on symbol rate, granularity = 1 Hz
Downstream Frame Structure	Includes sync word, uncoded control, coded control, and Reed Solomon code word, all of programmable size
d_nom	0x0000 through 0x000C and 0x0081 through 0x0083.

u_nom Value	Upstream Channel Symbol Rate	Upstream Channel Center Freq.
0x0000	Not a nominal value	Not a nominal value
0x0003	0.540 Mbaud	0.650 MHz

FIG. 16

d_nom Value	Downstream Channel Symbol Rate	Downstream Channel Center Freq.
0x0000	Not a nominal value	Not a nominal value
0x0001	1.620 Mbaud	3.420 MHz
0x0002	1.620 Mbaud	2.960 MHz
0x0003	3.240 Mbaud	3.950 MHz
0x0004	3.240 Mbaud	3.4425 MHz
0x0005	4.860 Mbaud	4.940 MHz
0x0006	4.860 Mbaud	4.4145 MHz
0x0007	6.480 Mbaud	5.920 MHz
0x0008	6.480 Mbaud	5.3865 MHz
0x0009	9.720 Mbaud	8.240 MHz
0x000A	9.720 Mbaud	7.331 MHz
0x000B	12.960 Mbaud	10.180 MHz
0x000C	12.960 Mbaud	9.275 MHz
0x0081	1.620 Mbaud	2.4705 MHz
0x0082	3.70286 Mbaud	3.720216 MHz
0x0083	4.05 Mbaud	3.9285 MHz
0x0084	5.67 Mbaud	4.9005 MHz
0x0085	4.32 Mbaud	4.0905 MHz
0x0086	5.184 Mbaud	4.6089 MHz

FIG. 17

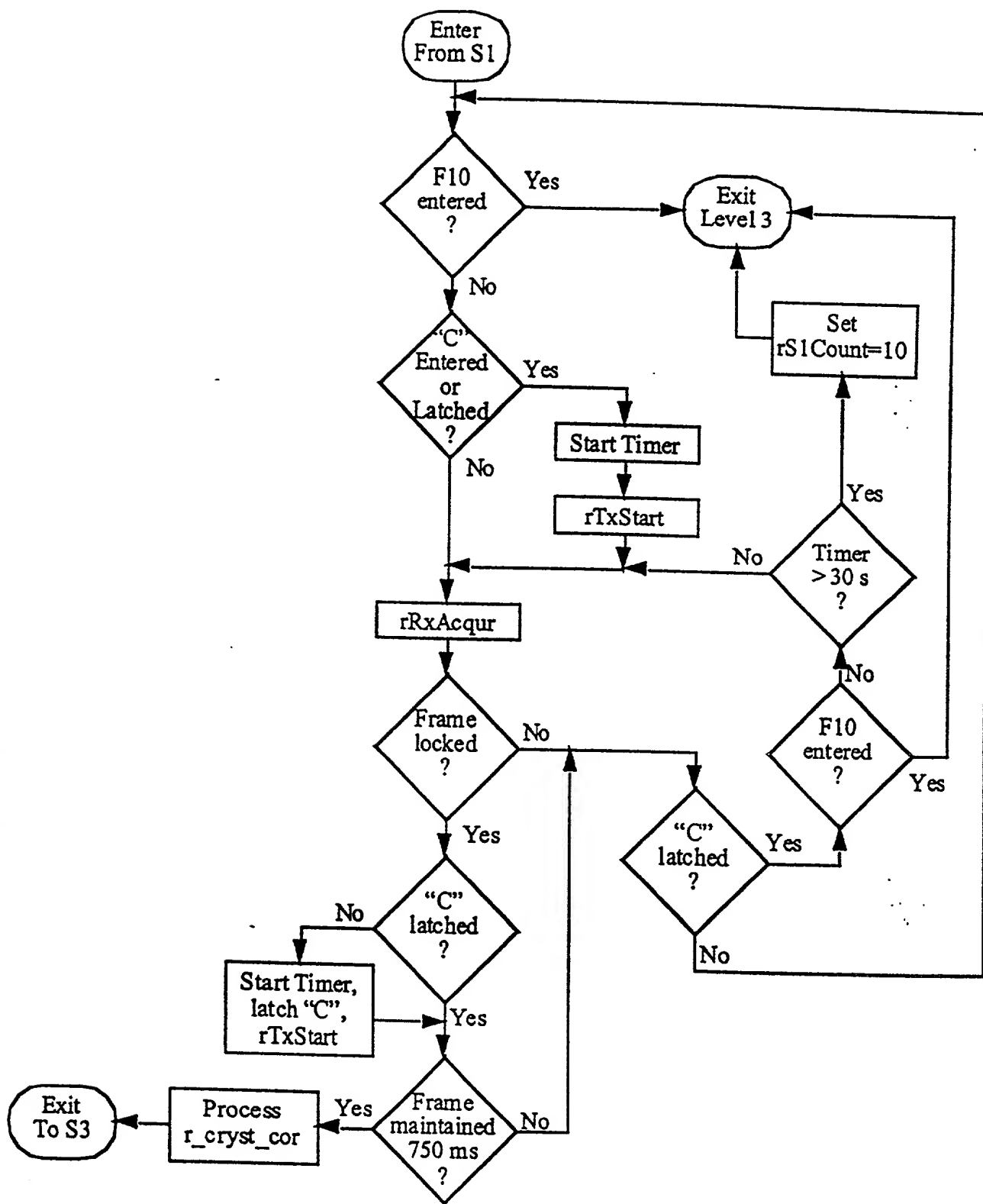


FIG. 18

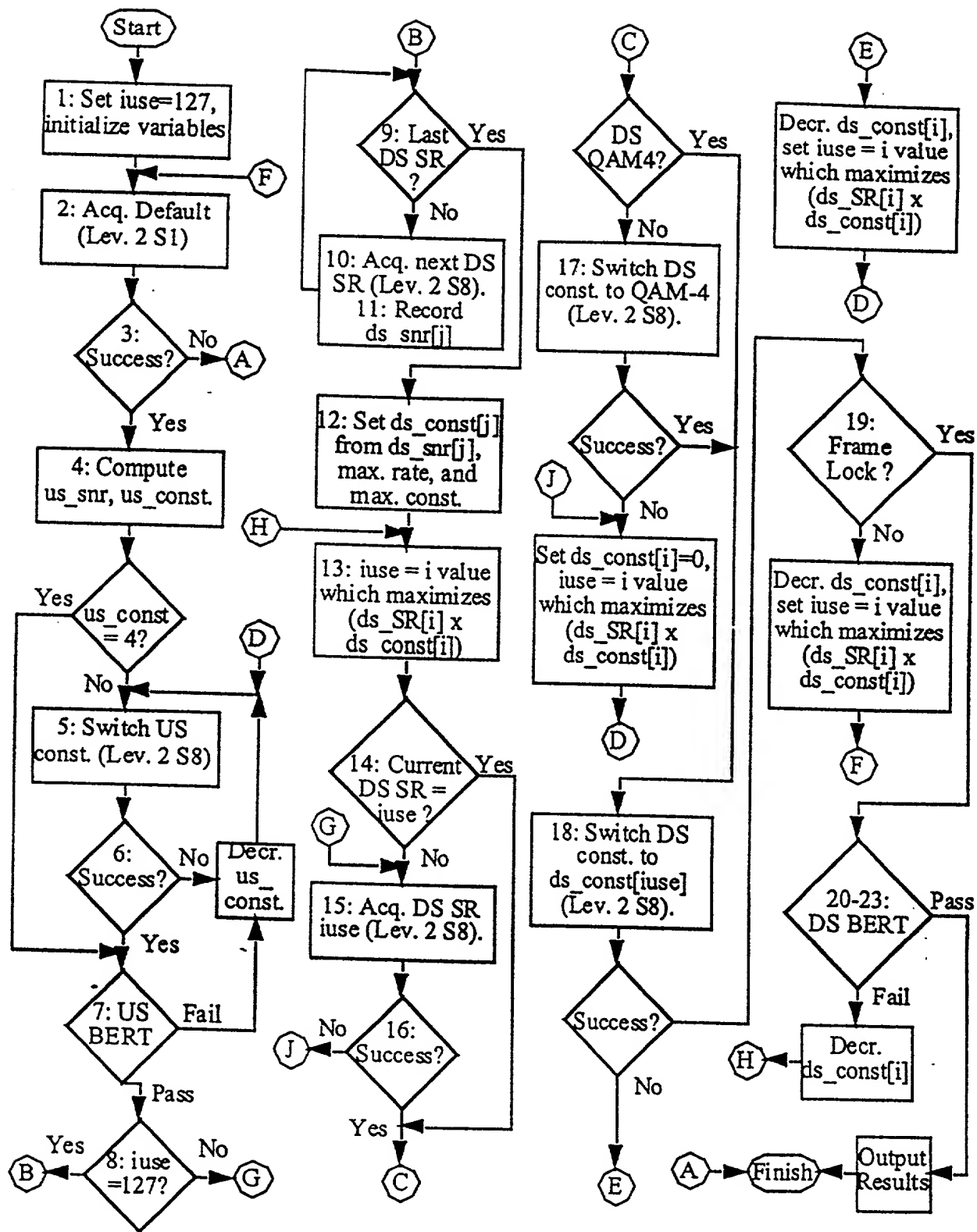


FIG. 19

FIG. 20

Average Upstream SNR – Upstream Margin	Upstream Constellation Value
Less than 19 dB	(QAM-4)
Between 19 dB and 22 dB	(QAM-16)
Between 22 dB and 25 dB	(QAM-32)
Between 25 dB and 28 dB	(QAM-64)
Between 28 dB and 31 dB	(QAM-128)
Greater than 31 dB	(QAM-256)

SNR – Downstream Margin	Constellation
Less than 10 dB	None
Between 10 dB and 19 dB	(QAM-4)
Between 19 dB and 22 dB	(QAM-16)
Between 22 dB and 25 dB	(QAM-32)
Between 25 dB and 28 dB	(QAM-64)
Between 28 dB and 31 dB	(QAM-128)
Greater than 31 dB	(QAM-256)

FIG. 21

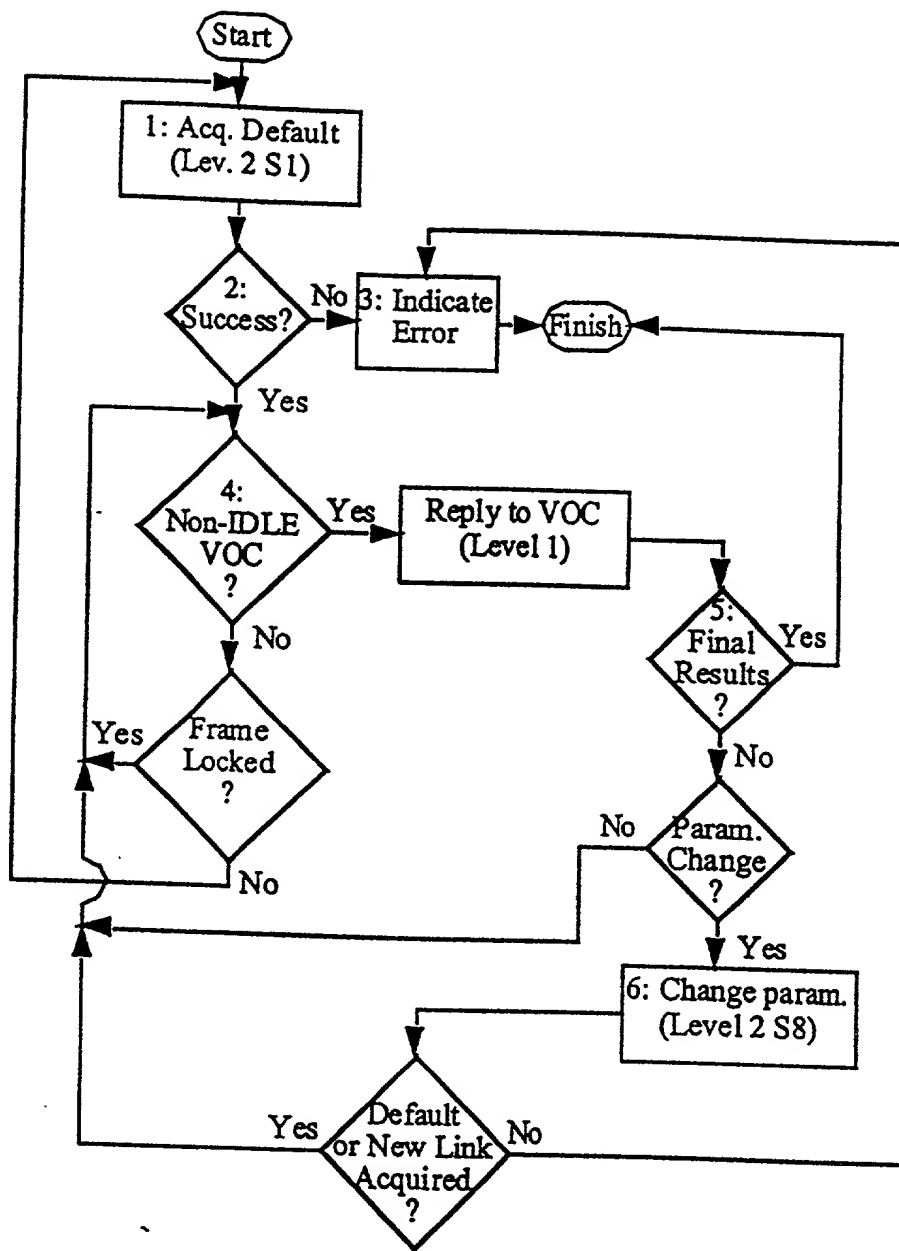


FIG. 22

FIG. 23

Message Name	Message Type	Opcode Field	Data Field	Description
IDLE	STATUS	0xFF	0x00	EOC transport
UTC	ECHO	0xF0	Same as messaged being UTC'ed	Unable To Comply message

Message Name	Message Type	Opcode Field	Data Field	Description
SNRREQ	COMMAND (READ) and ECHO	0x01	2 MSBs = DS channel #; 9 LSBs = COMMAND: All zeros. ECHO: Specified DS channel SNR in dB, LSB weight = 1/8 dB	Request that VTU-R send SNR data in the return data field
THRPUT	COMMAND (WRITE) and ECHO	0x03	Coded to convey final selected transmission parameters to VTU-R	Indication to VTU-R that rate adaptive startup is complete.
CORERREQ	COMMAND (READ) and ECHO	0x05	COMMAND: All zeros ECHO: Expect VTU-R's CORERR data as unsigned integer = # of errors (saturates at 65,535)	Request that VTU-R send number of errors corrected by RS in the return data field since the last CORERREQ
UCERREQ	COMMAND (READ) and ECHO	0x07	COMMAND: All zeros. ECHO: Expect VTU-R's UCERR data as unsigned integer = # of errors (saturates at 65,535)	Request that VTU-R send number of uncorrectable RS blocks in the return data field since last UCERREQ

FIG. 24

Message Name	Message Type	L1/L2 Class	Opcode Field	Data Field	Description
D_CONST	COMMAND (WRITE) and ECHO	L1	0x28	2 MSBs = DS channel #; 6 LSBs = $\log_2(\text{constel. size})$	Request that specified DS chan. # constel. be changed
D_NOM	COMMAND (WRITE) and ECHO	L1	0x34	Indicates which nominal DS symbol rate and center freq. set to use	Select nominal DS symbol rate and center frequency indicated in data field
U_CONST	COMMAND (WRITE) and ECHO	L1	0x98	2 MSBs = US channel #; 6 LSBs = $\log_2(\text{constel. size})$	Request that specified US chan. # constel. be changed
U_NOM	COMMAND (WRITE) and ECHO	L1	0xA4	Indicates which nominal US symbol rate and center freq. set to use	Select nominal US symbol rate and center frequency indicated in data field

FIG. 25